PATENT SPECIFICATION

516,268

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COMPLETE SPECIFICATION

Improvements in or relating to Gas Mask Filters and the like

We, FRANTISEK VOVES, BOHUSLAV FIEDLER and VILEM ECKHARDT, all citizens of the Czechoslovakian Republic, and all of Chotebor, Czechoslovakia, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to filters for extracting from the atmosphere noxious gases, vapours or solids contained therein.

According to the present invention there is provided a universal filter insert or filling for filters which are adapted to serve as a protection against noxious gases, vapours and solid substances in the atmosphere characterised by the fact that the effective body of the filter insert or filling is formed from a felted filtering mass comprising a homogeneous mixture of a fibrous material adapted for mechanical filtration and substances capable of effecting absorptive and adsorptive removal of the noxious components of the atmosphere.

The term "absorptive" refers to the removal of the noxious gases by chemical methods, that is by means of chemicals or reagents capable of neutralisation, hydrolysis or other decomposition of noxious gases. The term "adsorptive" refers to the physico-chemico filtration by means of adsorbent materials, such as active charcoal.

In order that the invention may be clearly understood and readily carried into practice, reference will now be made to the accompanying drawings.

Figure 1 represents a gas mask filter of an early type.

Figure 2 represents a later development of gas mask filter.

Figure 3 represents a further improved form of filter, of which

Figure 4 is an explanatory diagram.

Figure 5 illustrates by way of example a gas mask filter according to the present invention.

Figure 6 represents a section along the line x—x of Figure 5.

Figure 7 is an explanatory diagram referring to Figures 5 and 6.

Chemical, physico-chemical and mechanical filtration is used for removing from the atmosphere noxious substances that may be contained therein in gaseous form or as vapour or a cloud of solid materials.

Gas mask filters manufactured for this purpose usually consisted originally of three separate successive layers, as indicated in Figure 1, viz.:—a layer a consisting of a porous mass, e.g. diatomite, impregnated with suitable reagents for combining with and rendering innocuous chemically reactive substances such, for example, as phosgene; a layer b of an adsorbent mass, e.g. active carbon, whose especial function is to retain less reactive substances, such for instance as chloropicrin, by adsorption; and a layer c consisting of fibrous material which has been prepared either by a dry method in a free, stratified state, or else by a wet method in the form of solid bodies, the function of this layer being to retain by mechanical filtration solid and liquid substances that are distributed in the atmosphere as a mist or cloud, such for instance as diphenyl arsenious chloride.

A filter of this kind has the great disadvantage that the porous layer a constitutes a large ballast owing to its volume and weight, and on the other hand the strongly compressed layer of this carrier becomes caked together if stored for a length of time owing to the reagents therein and the moisture and pressure, and thus endamgers the fundamental properties of the filter, since its resistant life is shortened and its resistance to inhalation increased.

Later on a substantial improvement was effected by means of the construction that is frequently used nowadays, in which the porous carrier is reduced in bulk or wholly eliminated and replaced by active carbon into which the appropriate reagents are introduced directly.

The filter made up in this way (Figure 2) thus comprises only two layers, viz. an absorptive-adsorptive layer d of impregnated active carbon and another layer e

for mechanical filtration, which at the present time is usually made of special filter paper having suitable properties, from which filter inserts in the form of bellows are made by joining together round sheets of filter paper with a hole in the centre alternately at the edge and in the middle to form a closed body. This kind of filter has the disadvantage that it is necessary on the one hand to pay careful attention to the size of the grains of active carbon and on the other hand to use a special cellulose for the arsenious insert *e* in order to keep the resistance to respiration of the filter within the limits of the demands made thereon.

According to yet another proposal that has been made it is advantageous to use moulded hollow filter bodies made of a mixture of active carbon and cellulose, that is to say a combination of the second and third filtration stages of the first construction (see above), whilst the chemical or reactive layer is unchanged, so that a two-layer filter is again obtained, consisting (Figure 3) of a porous mass with reagents (layer *f*), and a hollow filter body *g* composed of a mixture of active carbon and cellulose for the adsorption and mechanical filtration.

This type of filter has found no practical application however, on account of the fact that the filtration in the part *g* occurs in the direction of the stratification of the individual components (Figure 4); actually the mixture of cellulose and active carbon is unevenly distributed on account of the difference in specific gravities, the upper strata g_1 containing more cellulose and less active carbon and the lower strata g_2 more active carbon and less cellulose, so that the filtration proceeds irregularly in different parts g_1, g_2.

It is an object of the present invention to remedy all the disadvantages of the previously known filters set out above and to provide a universal filter insert for all kinds of noxious substances, that is to say a filter insert having small resistance to respiration and long useful life and containing no substances that are ineffective for filtering purposes.

This is achieved according to the present invention by forming the effective body of the filter insert from a homogeneous filtration mass composed of a felted mixture of substances capable of the absorption, adsorption and mechanical filtration of noxious agents in the atmosphere.

It has also been proposed to provide a process of preparing filtering material for use in dust, fume, or gas masks in its original non-moulded or otherwise compounded condition in which a porous and fibrous material such as cellulose or paper is finely disintegrated, and a catalyst or an adsorbent or both is or are incorporated in this material.

In the filter according to this invention however, the effective body of the filter insert is formed from a homogeneous mass comprising a fibrous material in coherent, felted form. Advantageously the filter body is made up of plates of the filtering mass which are arranged so that the direction of stratification thereof is perpendicular to the general direction of flow of the gas, as illustrated in Figure 7 of the drawings. Furthermore, the air is uniformly exposed to all the constituents of the mass.

Such a filtering mass may be composed for example of cellulose mixed with active carbon and reagents (e.g. potash). Advantageously the filtering mass contains moisture, i.e. a certain water content, which has a great effect on the resistive life of the filter to various lethal gases.

We have found that the presence of potash is capable of maintaining a fixed content of moisture under varying atmospheric conditions during storage and in use of the filter.

Thus in accordance with the invention the fibrous substance (e.g. cellulose) acts as a carrier not only for active carbon but also for chemicals with or without water, thus achieving all-round effectiveness against all kinds of noxious substances.

The universal filter masses according to the invention can be produced by a wet process, in which the various constituents i.e. fibrous substance, active carbon and solution of the reagent used, are weighed out and thoroughly mixed in a hollander. The thin paste thus formed is worked further on a sieve, being kept constantly in agitation, so as to remove the excess solution of reagent, and the mixture is precipitated on the sieve in the form of a very homogeneous slab or sheet.

The proportions of the constituents of the filtering mass depend on the filtering properties required, and especially on the desired ratio between the resistive life relative to acid substances such as phosgene, and chemically indifferent substances such as chloropicrin.

A non limitative example of the composition of the filtering mass is:—

30% cellulosic matter
50% active charcoal
5% potash
15% moisture

The percentage of potash may be reduced and the content of moisture

correspondingly increased. The ratio of the cellulose matter to active charcoal depends largely on the specific properties of each of these materials and has to be determined separately for each given case.

By using different proportions of moisture and/or chemical reagents we control the ratio between the resistive life of the filter relative to phosgene and to chloropicrin, which are representatives of the main groups of noxious gases. If the ratio 1:1 is desired, we recommend for instance 17 to 19% of water in the filtering mass, and for the ratio 1:3 only 10% of water. If a longer resistive life against phosgene is required than against chloropicrin, the content of water may exceed 20%. The content of moisture may be easily varied to particular requirements in a filter which is ready for use.

In order to obtain universal efficiency of the filter against different noxious substances, the ratios of the individual constituents of the mixture will preferably be such that the resistive life of the filter relative to weakly reactive gases (e.g. chloropicrin) does not fall below the resistive life of the filter relative to reactive gases (e.g. phosgene).

The granulation of the active charcoal is chosen according to the type of fibrous material used. For long and thin fibres we use charcoal of very small grain size and nearly in powder form (0.01 mm); if the cellulosic material has short and thick fibres, it is better to use a larger grain size and only a very small proportion of small grain size.

The thickness of the filter layer relative to its area depends on the type of cellulose used, the type of active carbon, the degree of granulation of the latter, and the chemicals employed. It has to be determined separately for each particular purpose, and in making this calculation one must also take into account the resistance to respiration of the filtering plates and the absolute capacity to retain the poison gas cloud.

It is then possible to make up from the filter mass obtained filter inserts which are characterised by their ability completely to purify the atmosphere although they consist merely of plates or slabs of filtering material without any separate layers of chemically active fillings with carriers (sieves and the like).

By drying the slabs thus obtained so that they only possess the desired moisture content it is possible to obtain a mass having properties suitable for making universal filters of homogeneous nature which can be suitably arranged according to the size and shape of the filter, both superficially and spatially.

Figures 5 and 6 of the drawings illustrate by way of example an embodiment of the invention in vertical section and in horizontal section on line x—x. The filter insert consists of filter layers h composed of a felted mixture of fibrous material, active carbon or like adsorbent substance, and a reagent or reagents for chemically combining with or decomposing noxious substances in the atmosphere, for instance potash and a suitable moisture content, so that mechanical filtration (e.g. of arsine and other smoky substances), and chemical (e.g. for phosgene) and adsorptive actions (for less reactive gases and vapours) take place simultaneously in these layers. These filtering bodies or layers are assembled to form an insert, as indicated in Figure 5, where the bodies or layers are in the form of discs with stamped-out central openings i, with the exception of the layer h^1 which closes one end of the central passage and is made without an opening. These discs are joined together alternately in the middle and at the periphery by rings j, j^1 to form a bellows-like structure, and the rigidity of the structure is ensured by supporting spacers k or by other known means. The insert thus formed is placed firmly in the filter case l, preferably in such a manner that the filter discs h are not in direct contact with the walls of the case; in the embodiment illustrated the insert is supported relative to the case l by means of supports m at the top and n at the bottom. By removing the bottom o the insert can be withdrawn from the case and replaced. The arrows indicate the path taken by the air during the filtration. The case l has a pipe connection p in which a respiration valve r is arranged, and the wall of this connection is provided with a screw-thread for the attachment of the gas mask.

The filters according to the invention are not however, limited in their application to the particular constructions of a gas mask insert illustrated in and described with reference to Figures 5 and 6. On the contrary they may be used in varied forms, for example in the form of inserts comprising a plurality of chambers which are provided for impure air and which communicate with the outer atmosphere at one end of the filter, such chambers alternating with discharge channels forming chambers for purified air and communicating directly with the interior of the gas mask at the other end of the filter. The invention is also

applicable both to individual and collective filters.

With the aid of filters described the following advantages in particular are achieved:—

(1) Improved performance for the same filter content (about 20% over the current type).

(2) Reduced resistance to respiration in view of the greater filter area (about 50% of the usual constructions).

(3) Reduced weight of filter owing to the elimination of the sieve (about 20% of the total weight of the filter).

(4) Substantial reduction in price (to about 30% of the previous manufacturing costs), since cheap fibrous substances such as the cellulosic materials produced from wood, for instance in paper mills, can be used.

(5) Absolute resistance to corrosion, since the filtering mass does not come into contact with filter walls.

(6) Absolute resistance to moisture, since comparatively thick filtering plates can be used.

(7) Ready interchangeability of the whole filtering mass without damaging the filter case with connection piece.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A universal filter insert or filling for filters which are adapted to serve as a protection against noxious gases, vapours and solid substances in the atmosphere characterised by the fact that the effective body of the filter insert or filling is formed from a felted filtering mass comprising a homogeneous mixture of a fibrous material adapted for mechanical filtration and substances capable of effecting absorptive and adsorptive removal of the noxious components of the atmosphere.

2. A filter insert or filling according to claim 1, characterised by the fact that the filtering mass consists of a mixture of fibrous material with active carbon and one or more reagents for absorbing noxious components of the atmosphere, with or without a content of moisture.

3. A filter insert or filling according to claim 2, characterised by the fact that the proportion between the individual constituents of the mixture is such that the resistive life of the filter relative to weakly reactive gases (e.g. chloropicrin) is not less than the resistive life of the filter relative to reactive gases (e.g. phosgene).

4. A filter insert according to any of the preceding claims, characterised by the fact that the filter bodies are of large surface area and are formed by plates of the filter mixture.

5. A filter insert according to claim 4, characterised by the fact that the filter plates are of such size and thickness that the whole of the area of the filter is adapted to be uniformly contacted by the air, and are arranged with the direction of stratification thereof perpendicular to the general direction of flow of the gas.

6. A filter insert according to any of claims 3 to 5, characterised by the fact that the filter body or structure composed of the filtering mass is arranged on a removable component of the outer case of the filter and is adapted to be interchanged by removing this component from the case.

7. A filter insert according to any of claims 3 to 5, characterised by the fact that the insert is kept out of direct contact with the metal parts of the case of the filter to avoid corrosion thereof.

8. A method of producing the filter mass for inserts or fillings according to any of claims 1 to 7, characterised by the fact that the individual components of the mixture (fibrous material, active carbon and reagents) are mixed together thoroughly in the selected proportions by a wet method, and coherent sheets are made from the paste thus produced from which filter layers or chambers can be made up.

9. An insert or filling for filters for air containing noxious gases, vapours or solids, substantially as herein described with reference to Figures 5 to 7 of the accompanying drawings.

10. A method of producing filtering masses for filters for air containing noxious gases, vapours or solids, substantially as herein described.

Dated this 22nd day of July, 1938.
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London, W.C.2, and
Central House, 75, New Street,
Birmingham, 2,
Agents for the Applicants.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1940.

FIG. 1.

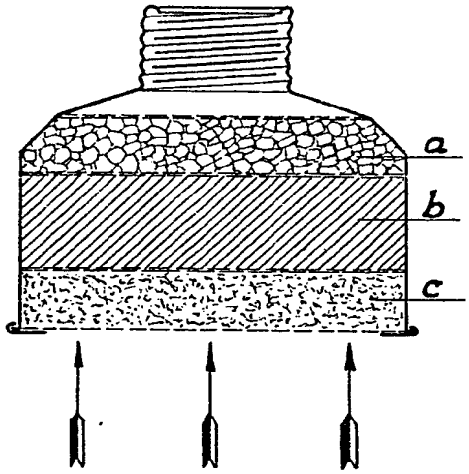


FIG. 2.

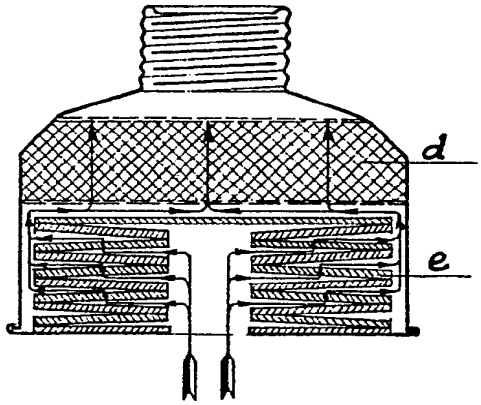


FIG. 3.

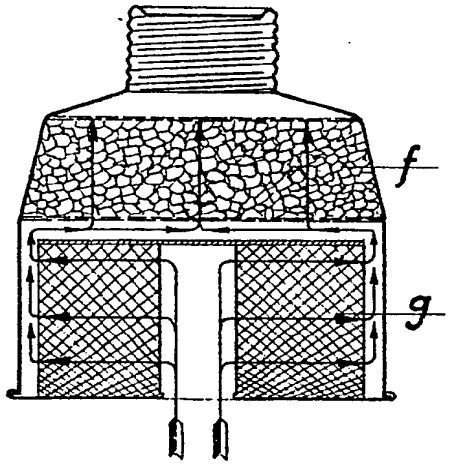


FIG. 4.

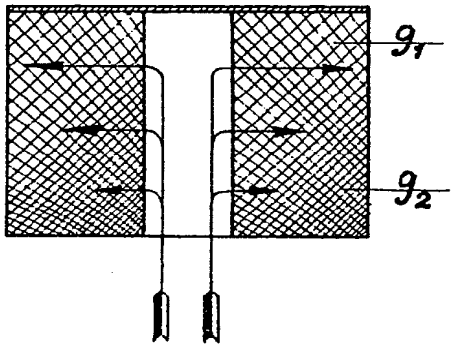
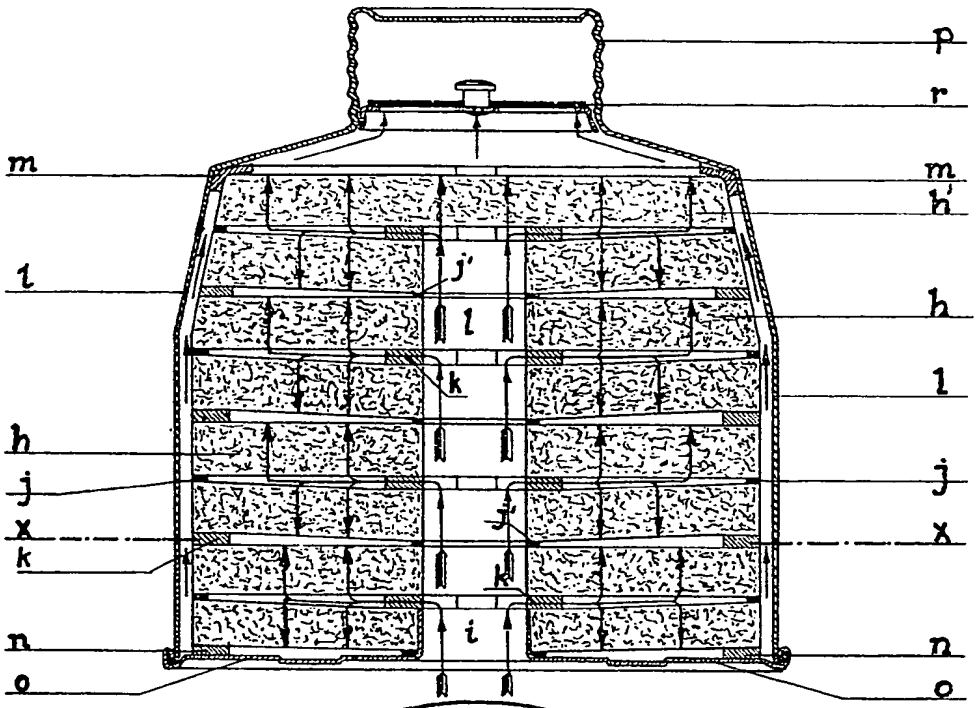


FIG. 5.



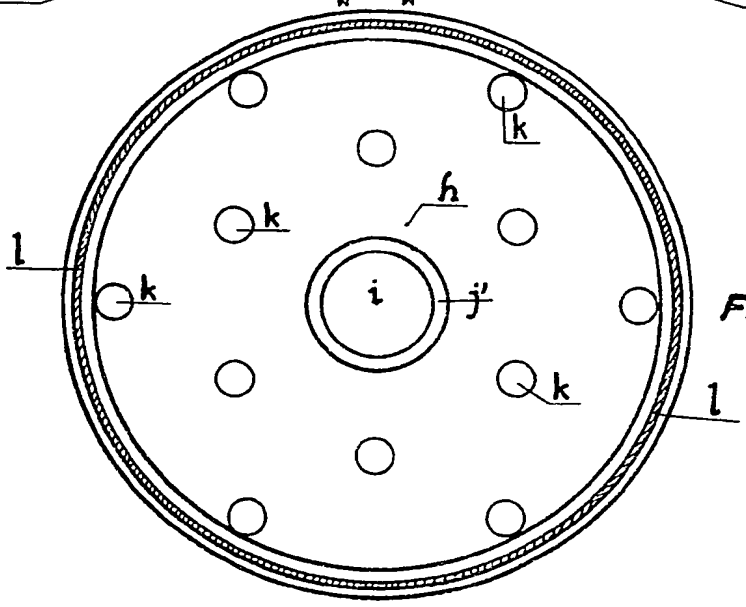


FIG. 6.

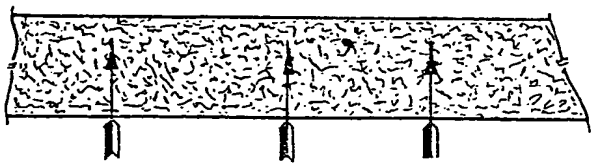


FIG. 7.

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2 SHEETS

SHEET 1

FIG. 1.

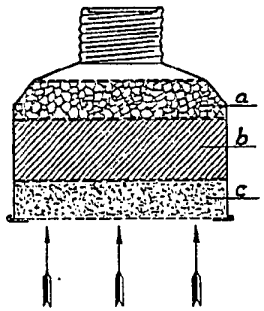


FIG. 2.

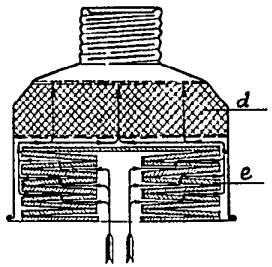


FIG. 3.

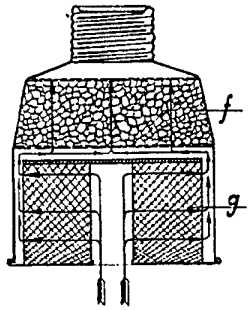
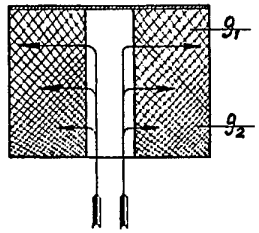
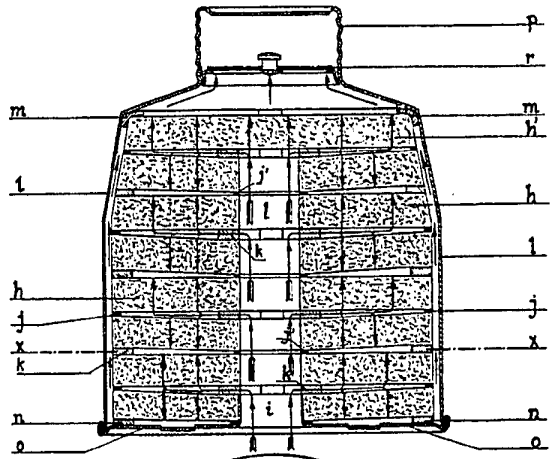


FIG. 4.



SHEET 2

FIG. 5.



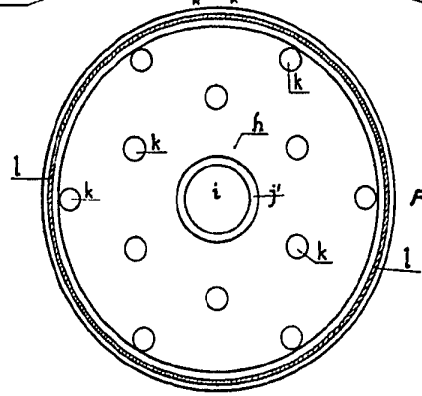


FIG. 6.

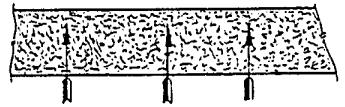


FIG. 7.

Malby & Sons, Photo-Litho